NASA Facts

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LIVING IN THE SPACE SHUTTLE

The idea that ordinary people would someday live and work in space has fascinated science fiction fans as well as serious scientists and engineers. NASA's Space Shuttle is the first step in turning this dream into reality.

The Space Shuttle is a reusable aerospace vehicle that takes off like a rocket, can be maneuvered in space, and lands like an airplane.

The spacecraft, called the orbiter, is about the size of a DC-9 commercial jetliner. The orbiter carries people and cargo between the ground and Earth orbit. It can also be used as an observation post in space and as a space platform for a fully equipped laboratory for medical, scientific, engineering, and industrial experiments.

One of the key attributes of the Shuttle and its operation is the relatively low g-force exerted on crew and passengers during launch and reentry. Launch and reentry forces are less than 4 g's — well within the limits which can be tolerated by healthy people.

Orbiter living accommodations are relatively comfortable. They incorporate advances made through nearly 2 decades of experimental manned space missions and an even longer period of ground studies.

Air is Purer Than Earth's

The orbiter's air is cleaner than Earth's, and hay fever sufferers will welcome its pollen-free atmosphere.

Orbiter air pressure is the same as Earth's at sea level: 1,033 grams per square centimeter (14.7 pounds per square foot). Its air is made up of 80 percent nitrogen and 20 percent other gases such as argon and neon. The orbiter's environmental control system circulates air through filters to remove carbon dioxide and other impurities. Excess moisture is also removed, keeping humidity at comfortable levels. Temperature in the orbiter can be regulated between 16 and 32 degrees Celsius (61 and 90 degrees Fahrenheit). The orbiter crew requires only ordinary clothing. People can move about, work, and relax unencumbered by bulky space suits.

An Attractive and Healthy Menu

Shuttle meals are tasty and nutritious. They can be eaten anywhere, although crew members normally congregate in the middeck area for their meals. Trays holding the food can be attached to a crew member's legs or to any orbiter surface with adhesive straps, removing the need for a table and chairs at mealtime. Meals are served in a special tray which separates the different food containers and keeps them from lifting off and soaring around in the weightless cabin.

Packages of food that have to be warmed are placed in the galley oven before going into the tray. Hot and cold water are available for preparation of foods or beverages.

Studies have shown that despite zero gravity, most foods can be eaten with ordinary spoons and forks as long as there are no sudden starts, stops, or spinning. As a result, dining in space is almost like dining on Earth.

The orbiter menu includes more than 70 food items and 20 beverages. With so many different items, Shuttle travelers can have varied menus every day for 6 days.

Earth-bound chefs might envy orbiter meal preparation — one crewmember can ready meals for four people in about 5 minutes.

What are orbiter meals like? A typical day's menus include orange drink, peaches, scrambled eggs, sausage, cocoa, and a sweet roll for breakfast; cream of mushroom soup, ham and cheese sandwich, stewed tomatoes, banana, and cookies for lunch; and shrimp cocktail, beefsteak, broccoli au gratin, strawberries, pudding, and cocoa for dinner.

Menus provide about 2,700 calories daily. Previous space missions demonstrated that astronauts need at least as many calories in space as they do on Earth.

The orbiter does not have a refrigerator. Most of the Shuttle foods are preserved by dehydration, which saves weight and storage space. Water for rehydration is ample since it is a byproduct of the fuel cells which generate electricity. Some foods are thermostabilized, that is, they are heat sterilized and then sealed in conventional cans or plastic pouches. A few, such as cookies and nuts, are available in ready-to-eat form.

Sanitation

Eating utensils are cleaned with wet wipes. The difference between orbiter wet wipes and those used on Earth is that the orbiter's contain a strong disinfectant.

Sanitation is more important in the confines of the orbiter than on Earth. Space studies have shown the population of some microbes can increase extraordinarily in a confined weightless area such as a spacecraft cabin. This could potentially spread illness to everyone on board. As a result, not only eating components but also the dining area, the toilet, and sleeping areas are regularly cleaned. Since there are no washing machines in space, trousers (changed weekly), socks, shirts, and underwear (changed every 2 days) are sealed in airtight plastic bags after

being worn. Garbage and trash also are sealed in plastic bags.

A favorite question of people interested in space is how the astronauts took care of digestive elimination. The orbiter travelers use a toilet very much the same as one on Earth. Air flow directs waste to the bottom of the toilet, substituting for gravity. Waste goes directly into a sealed container where it is processed and stored.

Some of the waste may be used for post-flight laboratory analyses. Such analyses have told doctors which minerals are lost excessively in space and have helped to increase their understanding of body functions.

Orbiter travelers have facilities and supplies available for sponge baths while in space. They can obtain water from the water dispensing system. Water temperature can be set at any comfortable level from 18 to 35 degrees Celsius (65 to 95 degrees Fahrenheit).

Because of weightlessness, water droplets would float about in the cabin. This could be not only a nuisance but also potentially hazardous to equipment and crew. To prevent this from happening, an airflow system directs waste water into the orbiter's waste collection system, where the waste water is sealed in plastic watertight bags.

Whiskers cut off in shaving and floating about weightlessly in a cabin could be a nuisance and foul up equipment. This problem is avoided by using conventional shaving cream and a safety razor and cleaning off the face with a disposable towel. Also available is a wind-up shaver that works like an electric razor and contains a vacuum device to prevent the escape of cut whiskers.

Unisex Space Suit Available

In the past, space suits were tailor-made for each astronaut, a time-consuming and costly process. The Shuttle space suit is manufactured in small, medium, and large sizes and can be worn by men or women. The suit comes with an upper and lower torso equivalent to a shirt and trousers. Each piece snaps together with sealing rings. A life-support system is built into the upper torso. Previous pressure suits had separate life support systems which had to be connected to the suits.

The Shuttle space suit is lighter, more durable, and easier to move about in than previous space suits. When an astronaut has to work outside the space-craft, the Shuttle suit is used for extravehicular activity.

Recreation and Sleep

Just as on Earth, recreation and sleep are important to good health in space. A scientifically planned exercise program is provided, largely as a countermeasure for cardiovascular deconditioning and atrophy of muscles in a weightless environment. Cards and other games, books, writing material, and tape recorders and tapes to chronicle personal observations or to listen to music, are available.

Weightlessness Still a Challenge

Many of the problems of going into space have been resolved. However, the physiological effects of weightlessness are still not completely understood. Among them are leaching of minerals from bones, reduction in rate of bone formation, atrophy of muscles when not exercised, and motion sickness.

All of the effects of zero gravity have so far been reversed after return to the normal gravity on Earth. In addition, some of the effects have been countered by exercise and food supplements.

However, even vigorous exercise in space does not appear to stop bone loss or decrease in the rate of bone formation. As a result, NASA is engaged in an intense and sustained effort aimed at understanding the causes underlying these changes and developing ways to prevent them. The increased information about body functions derived from this effort will pave the way for prolonged missions in space and contribute to our understanding of the physiology of living things on Earth.